



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/602,982   | 06/24/2003  | Jeff Nause           | 046361/265061       | 2036             |
| 826  | 7590        | 05/18/2005           | EXAMINER            |                  |
| ALSTON & BIRD LLP<br>BANK OF AMERICA PLAZA<br>101 SOUTH TRYON STREET, SUITE 4000<br>CHARLOTTE, NC 28280-4000 |             |                      | LEE, EUGENE         |                  |
|  |             |                      | ART UNIT            | PAPER NUMBER     |
|  |             |                      | 2815                |                  |

DATE MAILED: 05/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/602,982

Applicant(s)

NAUSE ET AL.

Examiner

Eugene Lee

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 07 February 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-15 and 17-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-15 and 17-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 February 2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Drawings***

1. The drawings are objected to because in claim 10, the applicant uses the term “passivation layer”, however, in FIG. 1, the applicant uses passive action layer. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

Art Unit: 2815

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1 thru 9, 12, 13, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. 6,469,315 B1 in view of Wolter 4,677,457. Suzuki discloses (see, for example, FIG. 1) a high electron mobility transistor 10 comprising a channel layer 13, gate electrode 21, and barrier layer (gate insulating layer) 17. In column 8, lines 3-6, Suzuki discloses the barrier layer comprising  $\text{Al}_c\text{Ga}_{1-c}\text{N}$  ( $0 \leq c \leq 1$ ) which is a Group-III nitride compound semiconductor. Suzuki does not disclose a channel layer being composed of a II-VI compound semiconductor zinc oxide. However, Wolter discloses (see, for example, FIG. 3a) a high electron mobility transistor comprising charge carrying layers (channel) 1, 2A, 2B. In column 5, lines 16-26, Suzuki discloses the layers comprising gallium arsenide (GaAs) and gallium aluminum arsenide (GaAlAs), however, in column 7, lines 62-column 8, lines 2, Wolter discloses that GaAs and AlGaAs can be replaced by other semiconductor materials such as ZnO (zinc oxide) in order to utilize different band gaps. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to have a channel layer being composed of a II-VI compound semiconductor zinc oxide in order to utilize different band gaps in a high electron mobility transistor, and since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Regarding claims 2, 3, 7, 13, 14, and 16, the limitations contain product-by-process language (i.e. epitaxially grown, piezoelectric doping, MOCVD, dummy gate), which does not patentably distinguish the product claims from the prior art.

Art Unit: 2815

Regarding claim 4, see, for example, column 8, lines 3-6, wherein Suzuki discloses the barrier layer comprising  $\text{Al}_c\text{Ga}_{1-c}\text{N}$  ( $0 \leq c \leq 1$ ).

Regarding claim 5, see, for example, column 8, lines 12-15, wherein Suzuki discloses the substrate may be made of sapphire, silicon carbide and the like.

Regarding claim 6, see, for example, column 3, lines 52-53, wherein Suzuki discloses the barrier layer having a thickness, for example, 2 nm (0.30 nanometer (nm) to 50 nm).

Regarding claim 8, see, for example, column 4, lines 1-2, wherein Suzuki discloses the gate electrode being made of gold (Au).

Regarding claim 9, see, for example, FIG. 1 wherein Suzuki discloses source electrode (source contact) 22 and drain electrode (drain contact) 23. In column 4, lines 9-13, Suzuki discloses the source and drain electrode having nickel (Ni) in a layered structure.

4. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. 6,469,315 B1 in view of Wolter 4,677,457 as applied to claims 1-9, 12, 13, and 17 above, and further in view of Shanfield et al. 5,880,483. Suzuki in view of Wolter does not disclose a passivation layer on said gate contact and said source and drain contacts. However, Shanfield discloses (see, for example, Fig. 3) a field effect transistor comprising a passivation layer 36 over a gate electrode 24, source electrode 20 and drain electrode 22. The passivation layer protects the top of the field effect transistor. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to have a passivation layer on said gate contact and said source and drain contacts in order to protect the top of the transistor.

Art Unit: 2815

5. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. 6,469,315 B1 in view of Wolter 4,677,457 as applied to claims 1-9, 12, 13, and 17 above, and further in view of Murota et al. US 2002/0109135 A1. Suzuki in view of Wolter does not disclose said gate contact being bounded by side walls of said gate insulating layer. However, Murota discloses (see, for example, FIG. 1) a transistor comprising a gate electrode 6, and an insulation layer (gate insulating layer) 7. The gate electrode is bounded by side walls of the insulation layer. It would have been obvious to one of ordinary skill in the art at the time of invention to have said gate contact being bounded by side walls of said gate insulating layer in order to enclose the gate electrode and prevent it from dispersing into the underlying channel layer.

6. Claims 14, 15, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. 6,469,315 B1 in view of Wolter 4,677,457 as applied to claims 1-9, 12, 13 and 17 above, and further in view of Nishikawa et al. 6,323,053 B1. Suzuki in view of Wolter does not disclose a ZnO substrate and the ZnO substrate being a c-surface substrate. However, Nishikawa discloses (see, for example, column 11, lines 50-55) a semiconductor device comprising a substrate made of ZnO and further discloses that a C surface can be used. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to have a ZnO substrate and the ZnO substrate being a c-surface substrate in order to form a semiconductor device thereon, and since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

7. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. 6,469,315 B1 in view of Wolter 4,677,457 as applied to claims 1-9, 12, 13, and 17 above, and further in view of Ando 6,429,467 B1. Suzuki in view of Wolter does not disclose the gate insulating layer being formed by metal organic chemical vapor deposition (MOCVD). However, Ando discloses (see, for example, column 4, lines 43-60) a field effect transistor comprising a gate insulating layer 13 wherein the gate insulating layer is formed by MOCVD. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to have the gate insulating film being formed by metal organic chemical vapor deposition (MOCVD) in order to adequately form the gate insulating film in a transistor.

#### *Response to Arguments*

8. Applicant's arguments with respect to claims 1-15, and 17-19 have been considered but are moot in view of the new ground(s) of rejection.

Regarding the applicant's arguments on page 13, first paragraph that Wolter fails to overcome the deficiencies of Suzuki, this argument is not persuasive. Wolter expressly discloses (see, for example, column 7, lines 57 – column 8, line 8) that II-VI compounds such as ZnO may be used as another semiconductor material instead of using gallium arsenide (GaAs) and gallium aluminum arsenide ( $\text{Al}_x\text{Ga}_{1-x}\text{As}$ ). In FIG. 3a, Wolter discloses the channel layer 1, 2A, 2B being made of gallium arsenide and gallium aluminum arsenide. Suzuki also discloses (see, for example, column 3, lines 35-36) a channel layer made of the same material GaAs. Therefore, it would have been obvious to one of ordinary skill in the art to use zinc oxide for the channel layer

Art Unit: 2815

in order to utilize different band gaps as a matter of obvious design choice (as disclosed by Wolter).

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

### **INFORMATION ON HOW TO CONTACT THE USPTO**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733. The examiner can normally be reached on M-F 8-5.

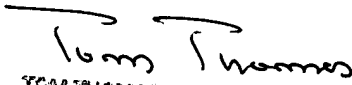


Art Unit: 2815

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 571-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Eugene Lee  
May 11, 2005

  
TOM THOMAS  
SUPERVISORY PATENT EXAMINER